General Physics

# DELAYED FEEDBACK CONTROL OF A CHAOTIC IMPACT OSCILLATOR

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Impact oscillators are a class of nonautonomous systems that include moving machinery parts, machine noise, induced vibration in fluids, moored ships, particle accelerators, transportation, separation of granular solids, and biology. The electronic bouncing ball is a representative impact oscillator that is an electronic analog of a mechanical ball bouncing on a driven vibrating table. The electronic version is convenient for study because it is a relatively noise free system, can operate at almost any frequency compared to the relatively low frequencies for the mechanical ball, and does not have added mechanical constraints usually required for real balls [1]. It is desirable to have a control mechanism that does not require extensive computational analysis before control can be initiated as in the Ott, Grebogi and Yorke (OGY) method [2]. Ideally, control should be initiated at an arbitrary time, without waiting for the system trajectory to enter a defined window about the desired controlled orbit. Pyragas [3] has introduced a modified version of the OGY approach, delayed feedback control (DFC). Our lab group has recently completed computer simulation in which DFC was successfully implemented to convert chaotic trajectories of the electronic bouncing ball to controlled period one trajectories. We discuss the experimental implementation of the DFC algorithm based on perturbations to the table amplitude rather than the table frequency, which is a more common approach. We show that our algorithm also addresses the potential shortfalls of simple DFC methods.

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[2] E. Ott, C. Grebogi, and J. A. Yorke, Phys. Rev. Lett. **64**, 1196 (1990).
[3] K. Pyragas, Phys. Lett. A **170**, 421 (1992).